FINAL REPORT
Project ID: **05-2-1-22**

Title: **The Impact of Prescribed Fire and Season of Burn on Amphibian and Reptile Biodiversity Patterns in Northern Longleaf Ecosystem Restoration.**

Location: **Experiments were conducted in the Oakmulgee District of the Talladega National forest. Field sites were in upland longleaf stands under prescribed fire management.**

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This final report details findings to date and accomplished deliverables. Most of the data will be analyzed as a part of a dissertation to be completed at the University of Alabama. Preliminary analyses are given in this report. Our webpage can also provide information on species collected at the experimental sites (http://bama.ua.edu/~firegrant/), and this should be considered a contribution to the final report.

I. MULTIVARIATE ANALYSES OF COMMUNITY STRUCTURE OF HERPETOFAUNA: Statistical overview.

1.) Diversity Indices: We found no significant variation in species richness ($F_{3,17} = 2.29$, df = 3, p = 0.115) or total abundance ($F_{3,17} = 1.454$, df = 3, p = 0.262) across burn intervals. There was variation, however, in the Shannon Index (H') ($F_{3,17} = 3{,}243$, df = 3, p = 0.04) and Shannon-derived evenness (E) ($F_{3,17} = 7.167$, df = 3, p = 0.003) between treatment groups. Fisher's LSD test further indicated that H' was lowest in stands managed under the 0-1 year burn interval, and that E was highest in stands managed under the >20 year burn interval.

2.) Multivariate analyses: These suggested a significantly unique community composition corresponding to the 0-1 year burn interval (via MDS of Bray-Curtis Similarity, cluster analysis, and ANOSIM). ANOSIM matched the patterns seen in the MDS plot, suggesting a unique community composition in the 0-1 year interval vs. all other treatment groups (Global R = 0.411, $p<0.01$ for all pairwise comparisons).

3.) Environmental variation: In addition to variability explained by burn intervals, three environmental variables contributed to variation in community composition (as determined via the BVSTEP routine in Primer-E). Longleaf stand area, average temperature, and % hardwood forest composition within a 500 m buffer of each trap site were found to be the three highest stepwise variables contributing to community variation out of a list of eight variables ($\rho = 0.327$). This suggests that microclimate (temp.) has a hand in driving community variability (often influenced by burning), and that in addition to burn intervals alone, forest managers should also take into account the larger landscape component of their fire management programs (e.g. stand/compartment size, configuration of nearby burn compartments across landscapes, etc.).

****Overall, the buzzwords here seem to be heterogeneity and complexity in fire management…much like we would see in a naturally burned landscape (e.g. lightning induced fires). There was no "ideal" burn interval found in our analyses, rather a dynamic mosaic of the herpetofaunal community that shifts across landscapes spatially and temporally with changes in burning, and is influenced locally by multiple variables from the entire landscape.*

Season of burn: There was no statistical variation in season of burn, although our replication was prohibitively low to answer this question concretely.

II. FIGURES OF SAMPLING SCHEME AND BASIC STATISTICS.

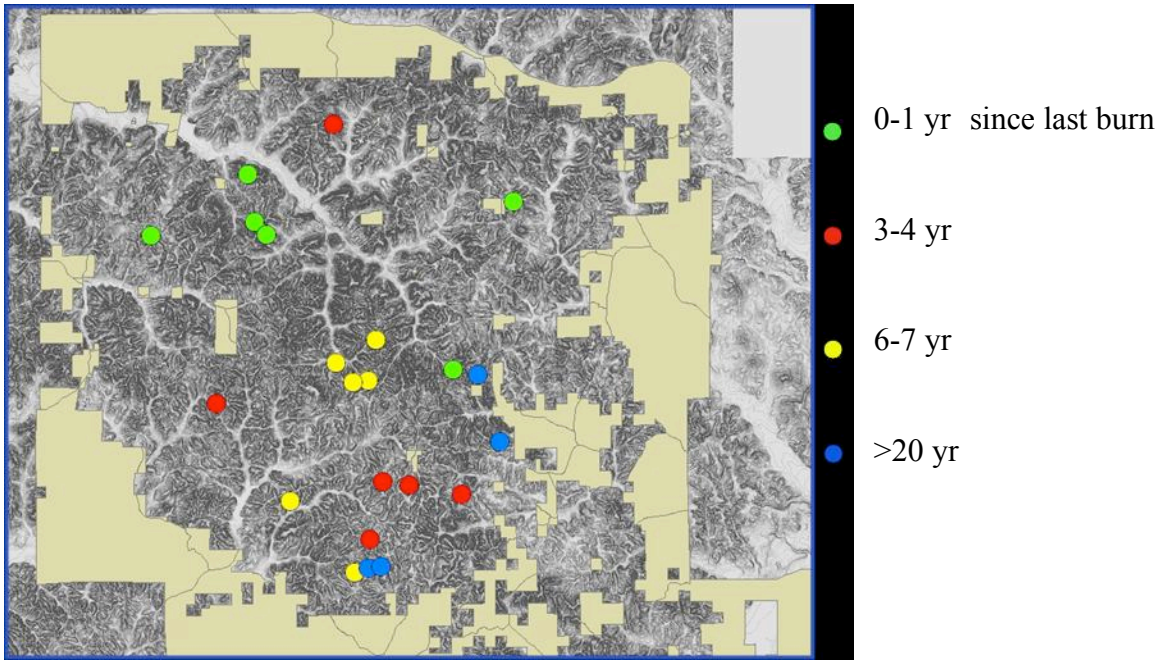


Fig. 1. Trap sites on the Oakmulgee. Green = 0-1 yr since last burn; Red = 3-4 yr; Yellow = 6-7 yr; and Blue = >20 yr.

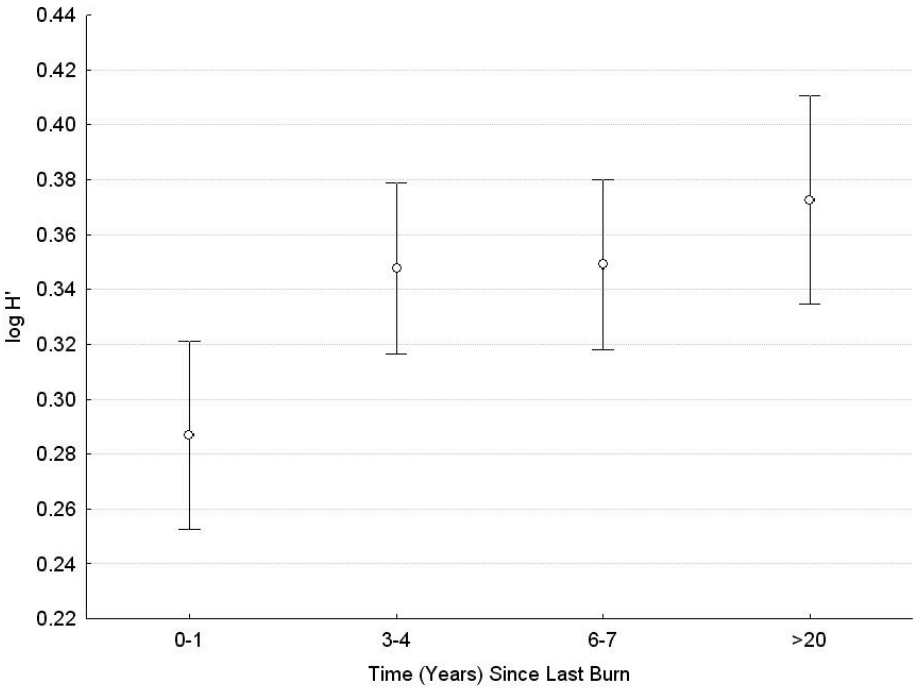


Fig. 2. ANCOVA of diversity of amphibians and reptiles plotted against time since last burn. Lowest diversity occurred immediately after a burn, and then regained high diversity after about 3 years post burn. ANCOVA was done using log-transformed Shannon Index values by treatment group (time since last burn), with nearest straight-line distance to stand edge (m) as a covariate. Stats.: $F_{3,16} = 4.8739$, df = 3, p = 0.014. Fisher's LSD indicates 0-1 year group is significantly lower than all other treatment groups.

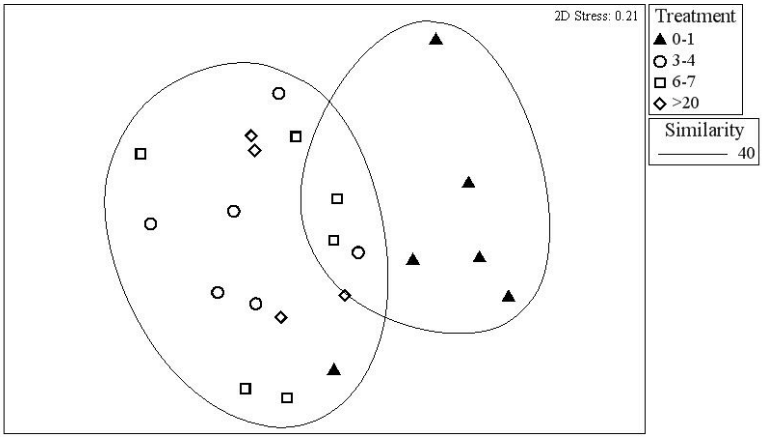
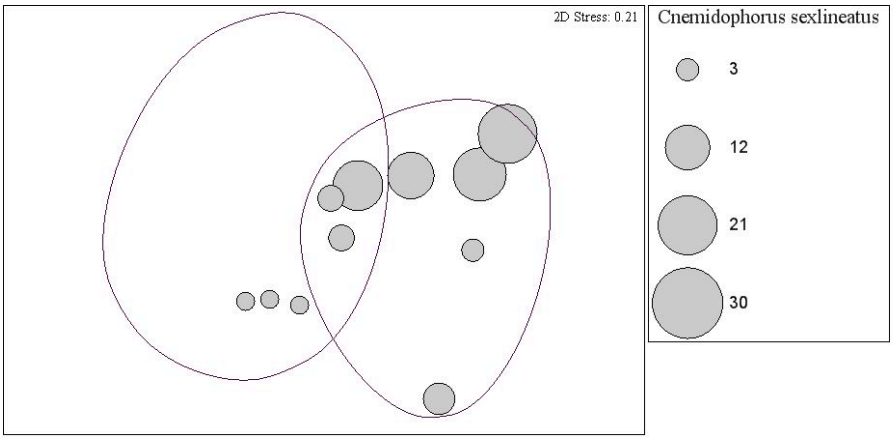
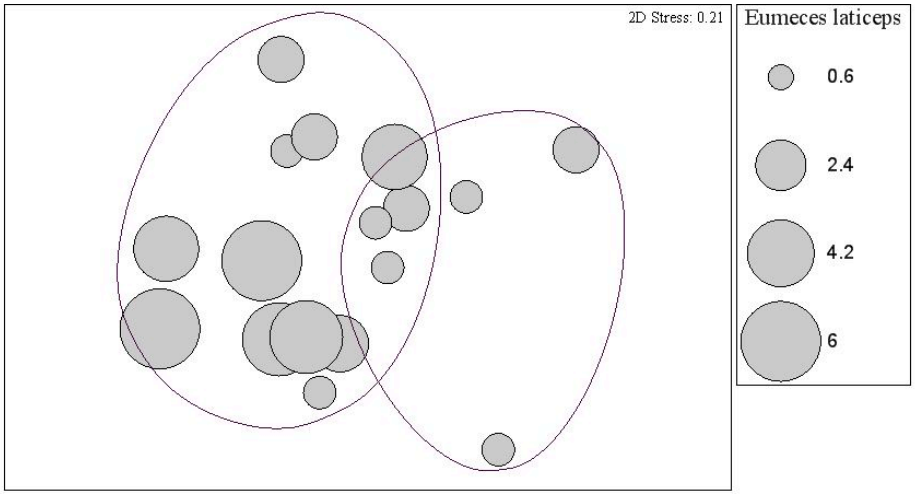


Fig. 3. Multidimensional scaling of Bray-Curtis similarity values for trap sites in the Talladega NF, grouped by burn treatment. Delineated groups of similarity (black circles) calculated by a cluster analysis overlay.
Stats.: ANOSIM (not indicated on graph): R = 0.569, p = 0.016 (all pairwise comparisons of 0-1 group vs. others significant)

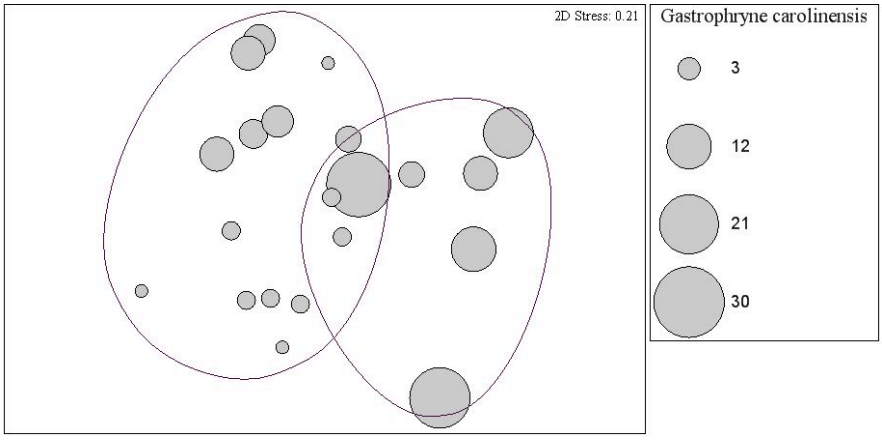
A)


2D Stress: 0.21
Cnemidophorus sexlineatus
3
12
21
30

B)


2D Stress: 0.21
Eumeces laticeps
0.6
2.4
4.2
6

C)


2D Stress: 0.21
Gastrophryne carolinensis
3
12
21
30

D)

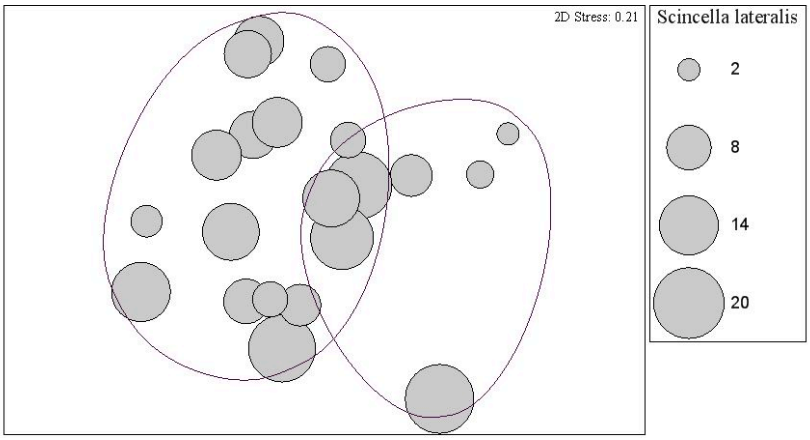


Fig. 4. Bubble plots of selected herpetofaunal species in the Talladega NF, grouped by statistically unique species assemblages. For all bubble plots, the diameter of each bubble represents the relative abundance of the indicated species at a given trap site. A) *Cnemidophorus sexlineatus* (Six-lined Racerunner); B) *Eumeces laticeps* (Broad-headed skink); C) *Gastrophryne carolinensis* (Eastern Narrowmouth Toad); and D) *Scincella lateralis* (ground skink).

III. MANAGEMENT IMPLICATIONS

Our data suggest that herpetofaunal communities respond to prescribed burning in the Talladega National Forest not by a presence-absence relationship of species between burn intervals but rather by changes in community composition as a result of shifts in relative abundances of those species. Landscape-level analyses indicate that variation in average temperature is the most contributing microclimatic factor to these patterns, as is longleaf stand area. Accordingly, herpetofaunal communities in longleaf pine stands within the Talladega National Forest likely exist in a dynamic mosaic of burn intervals that shift across the landscape spatially and temporally with succession. We recommend that heterogeneity be continued with respect to prescribed burning intervals within this forest to mimic the complexity that likely existed in presettlement forests due largely to lightning-induced fires.

In addition to fire interval, our data also illustrated a larger landscape component to herpetofaunal community composition that should likely be taken into account from a management perspective. Longleaf stand area and percent hardwood forest composition within a 500m radius of each drift-fence array (as determined via geospatial analysis) also contributed to herpetofaunal community composition in longleaf pine stands. While prescribed burning seems to be the predominant factor influencing these communities, we recommend that these additional factors be taken into account, as well. That is, we recommend that configuration of burn

compartments be arranged in the landscape to ensure proper dispersal of organisms can occur within and between forest stands managed under different burn intervals. This is to ensure that maintenance of herpetofaunal diversity continues within this system.

Future studies should examine how the upland longleaf ecosystem is connected to the wetland, bottomland forest in terms of species composition, dispersal through corridors, etc. Genetic analyses would also be beneficial and could provide more robust data on dispersal, etc. through the forest stands. Genetic analyses would also provide information on patterns of genetic diversity as it relates to landscape structure driven by fire regime. High genetic diversity of populations is essential for continued health and adaptability of individuals in the face of climate change.

Appendix I. The "deliverable" table from our JFSP proposal with what was proposed, what actually was delivered, and the status. The updated JFSP deliverable sheet on your webpage (https://www.firescience.gov/PSR/index.cfm) has even more deliverables that were completed and that are in progress.

Deliverable	*Delivery Date(s)-in proposal*	*actual*	*Status*
Amphibian and Reptile monitoring techniques	2005-2006 (data collection)	same	done
Final report USFS	December 2008	Done September 2008	done
Species Inventory List	final form May 2008	website completed: http://bama.ua.edu/~firegrant/	done
Workshops (with field excursions)	May 2007; October 2008	Many more workshops were done than stated in the original proposal.	done
Powerpoint Presentations; pamphlets	initial form June 2007; final Dec 2008	Several powerpoint presentations were given at meetings and posters were given at meetings.	done
Webpage with Species I.D.s	Summer 2008	website completed: http://bama.ua.edu/~firegrant/	done
Scientific Publication(s) (peer-reviewed literature)	submitted Dec 2008 (after data analysis)	This is a work in progress. One Ph.D. student is working on this project as his dissertation. One publication has been submitted to Journal of Applied Ecology	In progress
Tissue Samples in UA Herpetological Collection (genetic studies)	continual beginning 2006	All curated into UAHC museum	done